



Rail Accident Investigation Branch

Rail Accident Report



Uncontrolled evacuation of a partially platformed train at Clapham Common London Underground station, 5 May 2023

Report 03/2024
May 2024

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC
- the Railways and Transport Safety Act 2003
- the Railways (Accident Investigation and Reporting) Regulations 2005.

© Crown copyright 2024

You may reuse this document/publication (not including departmental or agency logos) free of charge in any format or medium. You must reuse it accurately and not in a misleading context. The material must be acknowledged as Crown copyright and you must give the title of the source publication. Where we have identified any third party copyright material you will need to obtain permission from the copyright holders concerned. This document/publication is also available at www.gov.uk/raib.

Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Email: enquiries@raib.gov.uk
Telephone: 01332 253 300
Website: www.raib.gov.uk

This report is published by the Rail Accident Investigation Branch, Department for Transport.

Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where RAIB has described a factor as being linked to cause and the term is unqualified, this means that RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident or incident that is being investigated. However, where RAIB is less confident about the existence of a factor, or its role in the causation of the accident or incident, RAIB will qualify its findings by use of words such as 'probable' or 'possible', as appropriate. Where there is more than one potential explanation RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident or incident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, words such as 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the accident or incident being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of RAIB, expressed with the sole purpose of improving railway safety.

Any information about casualties is based on figures provided to RAIB from various sources. Considerations of personal privacy may mean that not all of the actual effects of the event are recorded in the report. RAIB recognises that sudden unexpected events can have both short- and long-term consequences for the physical and/or mental health of people who were involved, both directly and indirectly, in what happened.

RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

This page is intentionally left blank

Uncontrolled evacuation of a partially platformed train at Clapham Common London Underground station, 5 May 2023

Contents

Preface	3
Summary	7
Introduction	8
Definitions	8
The incident	9
Summary of the incident	9
Context	10
The sequence of events	17
Events preceding the incident	17
Events during the incident	17
Events following the incident	20
Background information	21
Analysis	23
Identification of the immediate cause	23
Identification of causal factors	23
Identification of underlying factors	32
Factors affecting the potential severity of consequence	38
Observations	39
Summary of conclusions	40
Immediate cause	40
Causal factors	40
Underlying factors	40
Additional observations	41
Previous RAIB recommendations relevant to this investigation	42
Actions reported as already taken or in progress relevant to this report	44
Recommendations and learning point	46
Recommendations	46
Learning point	47

Appendices	48
Appendix A - Glossary of abbreviations and acronyms	48
Appendix B - Investigation details	49
Appendix C – Research on crowd behaviours during an emergency	50

Summary

At around 17:43 hrs on Friday 5 May 2023, a London Underground train departing from Clapham Common station was brought to a halt by a passenger emergency alarm activation after smoke and a smell of burning entered the train. The train came to a stand with two cars inside the tunnel and four cars adjacent to the platform. The train's doors remained closed. Around 100 of the train's (estimated) 500 passengers subsequently self-evacuated onto the platform through the interconnecting doors between the train's cars and the train's windows, some of which were broken by passengers either inside the train or on the station platform. Station staff began opening the train's doors around four and a half minutes after the train came to a stand.

The incident resulted in minor injuries being reported by a few passengers. However, it had the potential to have more serious consequences, not least because Clapham Common station has a narrow island platform which increases the risk of passengers falling onto the track and potentially being exposed to conductor rails and trains approaching on the adjacent southbound line.

RAIB's investigation found that passengers perceived a significant risk from fire, and that they became increasingly alarmed when the train's doors remained closed and they did not receive suitable information or see any effective action from London Underground staff.

An underlying factor to the incident was that operational staff were not provided with the procedures or training needed to effectively identify and manage incidents where passenger behaviour can rapidly escalate. A possible underlying factor was that London Underground did not fully apply and retain learning from a previous similar incident at Holland Park station. Additionally, a further possible underlying factor was that London Underground had not identified the risk of passenger self-evacuation from partially platformed trains, including those taking place at narrow island platforms.

RAIB has made three recommendations, all addressed to London Underground. The first relates to procedures and training to ensure that staff have clear guidance on how to deal with out-of-course events. The second relates to learning from previous incidents not being lost and to recommendations being tracked through to implementation. The third recommendation is that London Underground review its risk assessment processes so that the risks associated with out-of-course events and at specific locations are effectively identified and assessed.

Introduction

Definitions

- 1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.
- 2 The report contains abbreviations and acronyms, which are explained in appendix A. Sources of evidence used in the investigation are listed in appendix B and research documents are listed in appendix C.

The incident

Summary of the incident

- 3 At around 17:43 hrs on Friday 5 May 2023, a northbound Northern line train departing from Clapham Common London Underground station was halted by the operation of a passenger emergency alarm (PEA). The train came to a stand with two of the train's six cars in the running tunnel and the remainder of the train in the platform. The train's doors remained closed and locked.
- 4 Passengers in the train became aware of smoke and a burning smell, and unsuccessfully attempted to force open the train's bodyside doors. Around 2 minutes and 23 seconds after the train had stopped, the station's automated station evacuation alarm sounded and, at around the same time, passengers began exiting the train through the interconnecting doors which lead between the train's cars. Twenty seconds after this alarm sounded, passengers on the station platform began to break the train's bodyside windows and passengers inside the train also began to break these windows and evacuate through the openings onto the platform (figure 1).



Figure 1: Closed-circuit television (CCTV) footage from Clapham Common station platform at 17:45 hrs; the camera is facing towards the steps leading to the platform. Left-hand image shows a passenger breaking a bodyside window on car 5 of train 065 and right-hand image shows passengers beginning to evacuate from the train via the broken window (courtesy of LUL).

- 5 Around 4 minutes and 38 seconds after the train stopped, a London Underground customer service assistant (CSA) began to manually open the train's doors from the platform and passengers began to evacuate in a controlled manner. However, it was later determined that around 100 of the train's (estimated) 500 passengers had self-evacuated from the train during the incident. Some passengers reported that they had sustained minor injuries while self-evacuating the train and other passengers on the train were clearly distressed by the incident.
- 6 It is possible a more serious incident could have occurred during the passengers' self-evacuation, particularly given the narrow island platform in use at Clapham Common station. However, shortly after the northbound train had been brought to a halt, a southbound train had arrived on the other side of the island platform, reducing the risk of passengers falling from the platform.

Context

Location

Clapham Common station

- 7 Clapham Common station is on the southern branch of London Underground Limited's (LUL) Northern line which terminates at Morden. Northbound services from this station connect to the line's central and northern branches and to the line's other southern branch, which terminates at Battersea Power Station.

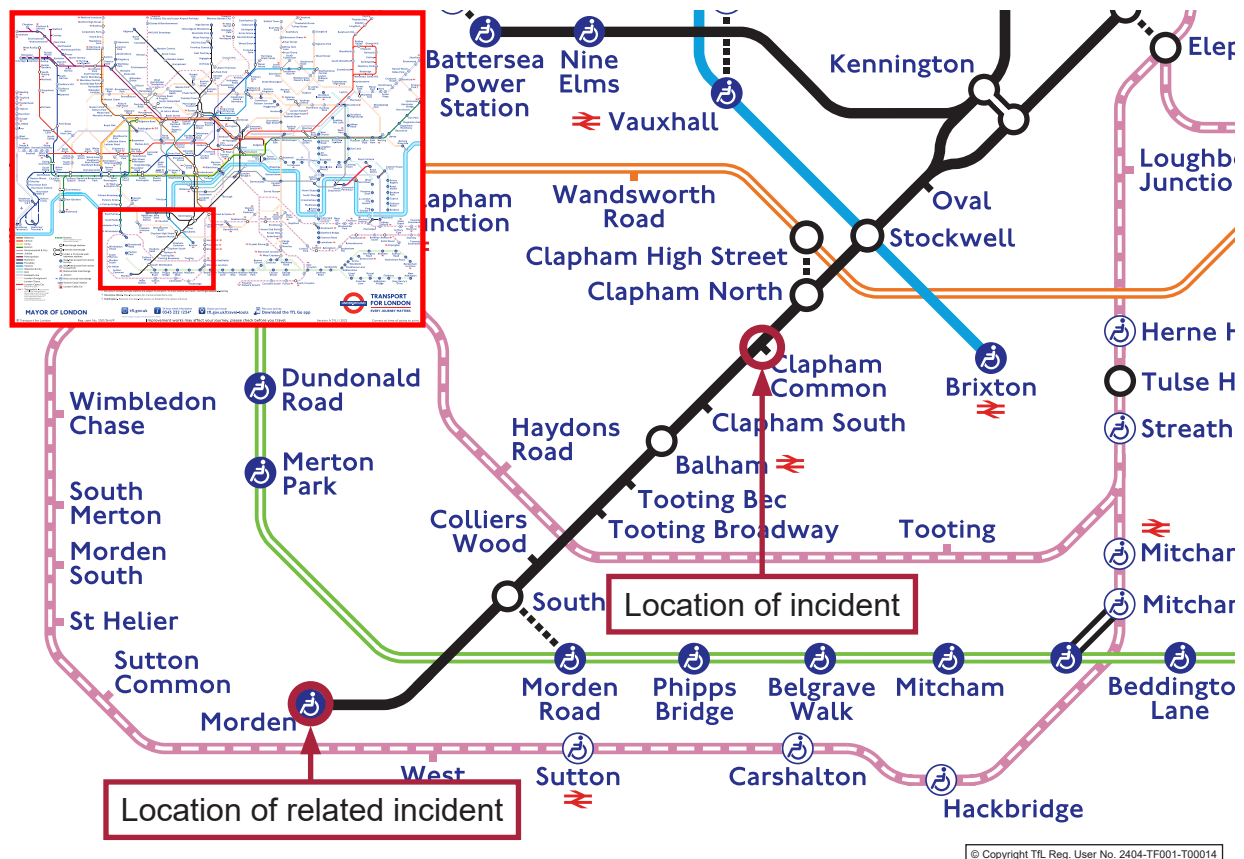
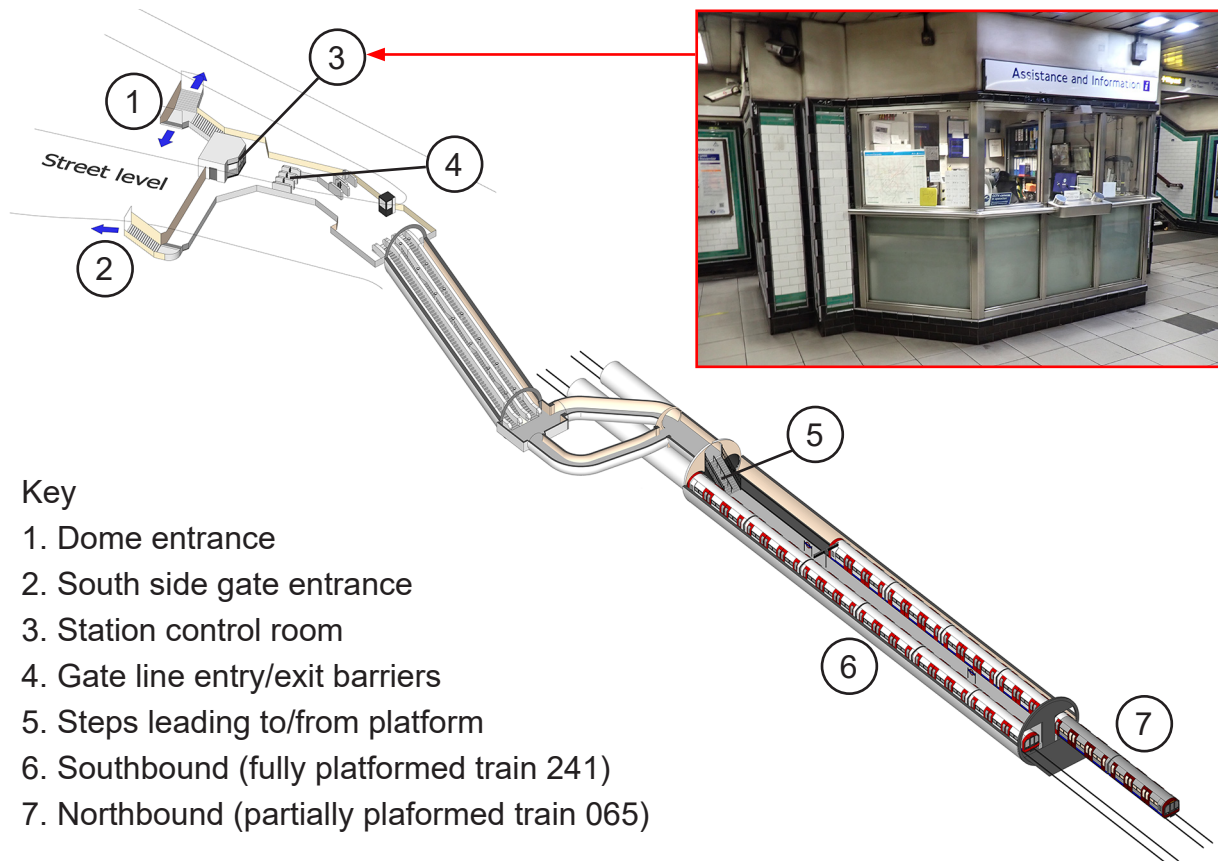


Figure 2: Extract from London Underground map showing location of incident at Clapham Common station and related incident at Morden station (courtesy of Transport for London).

- 8 Clapham Common platform can be accessed from street level via two entrances. Stairs connect both entrances to a ticket hall which contains a line of ticket barriers and a station control room. The platform is accessed from the ticket hall via an escalator and a further set of stairs.
- 9 The station's island platform is around 20 metres below ground level and 3.7 metres wide. The platform serves both northbound and southbound Northern line services. Traction current is supplied to both lines by a nominal 630-volt DC conductor rail electrification system. This uses two conductor rails, one in the middle of the track and one on the side furthest from the platform.



Key

- 1. Dome entrance
- 2. South side gate entrance
- 3. Station control room
- 4. Gate line entry/exit barriers
- 5. Steps leading to/from platform
- 6. Southbound (fully platformed train 241)
- 7. Northbound (partially platformed train 065)

Figure 3: Diagram of Clapham Common station including positions of northbound train (after being brought to a halt after a PEA activation) and southbound train after stopping at platform a short time later (see paragraph 36). Inset image shows station control room within ticket hall.



Figure 4: Clapham Common station's island platform from the top of the stairs leading to the platform (northbound line left-hand side and southbound line right-hand side of platform).

- 10 There are six passenger help points (PHPs) in Clapham Common station, which include a fire alarm button and a message that states: *'If you see fire or smoke operate this fire alarm'*. If fire alarms from two PHPs are activated on the station, an automated evacuation message will be sounded repeatedly throughout the station which states: *'Ladies and gentlemen, your attention please. Due to a reported emergency, will all passengers leave the station immediately.'*

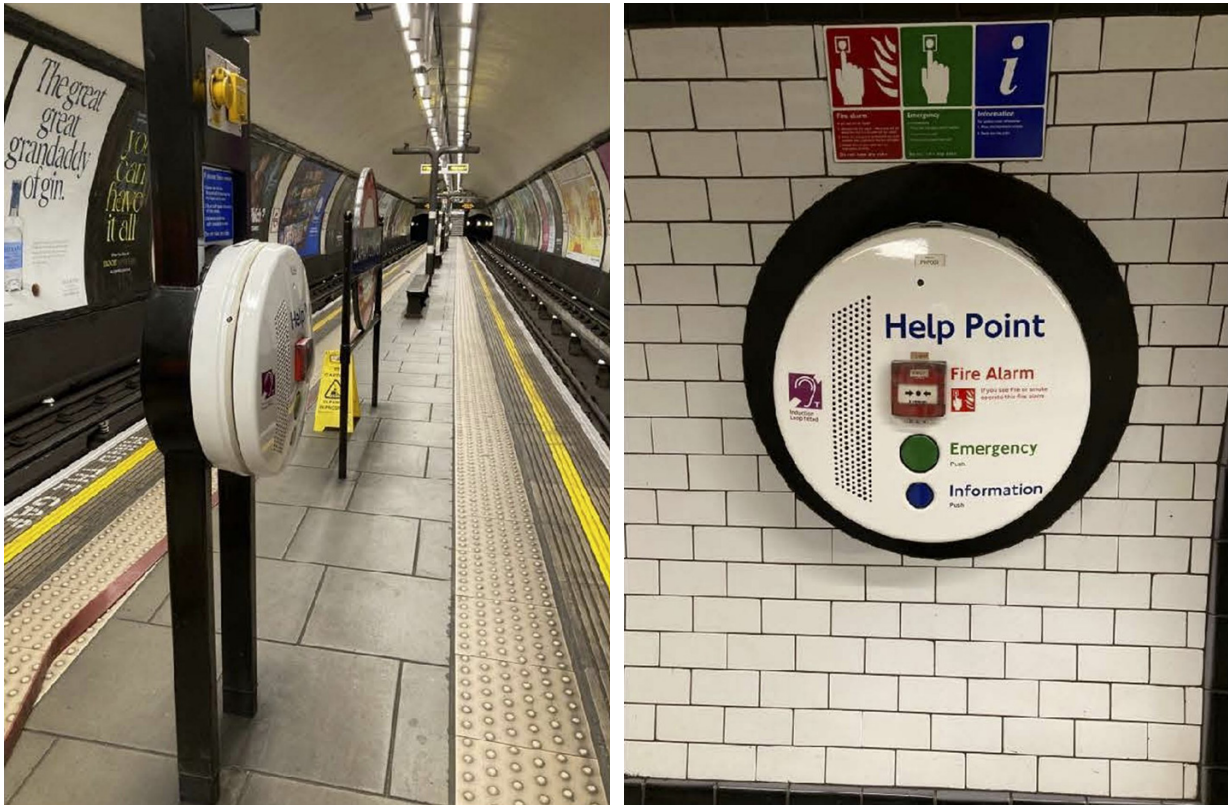


Figure 5: PHPs at Clapham Common station (left-hand side image on platform and right-hand side image elsewhere within the station). Courtesy of LUL.

Highgate Service Control Centre (SCC)

- 11 LUL's Northern line service is controlled from Highgate Service Control Centre (SCC) which is approximately 13.5 km north of Clapham Common. The control room floor accommodates the service control staff that responded to the incident (see paragraph 29).
- 12 Control staff at Highgate SCC can make station announcements remotely at some Northern line stations, but this facility was not installed at Clapham Common station at the time of the incident. Additionally, control staff are able to communicate with passengers on trains, but this facility is only available if a train operator is unable to acknowledge a vigilance device in the cab.



Figure 6: Control room floor at Highgate SCC. Foreground shows desk for line information specialist (LIS) and background shows service controller and other signaller desks.

Organisations involved

- 13 LUL is a wholly owned subsidiary of Transport for London (TfL). It is the infrastructure maintainer of the Northern line and the owner of the trains involved in the incident. It also operates the trains and is the employer of all the railway staff involved in the incident and the subsequent response.
- 14 Alstom Transport UK Ltd (Alstom) built and maintains the trains involved.
- 15 London Fire Brigade (LFB) provides emergency fire and rescue services in the Greater London region.
- 16 All the organisations involved freely co-operated with the investigation.

Trains involved

- 17 Both the incident train (northbound, running number 065, consisting of unit numbers 661 and 662) and the train which subsequently arrived on the other side of the platform (southbound, running number 241) were 1995 tube stock. These trains, which consist of six cars,¹ were built by Alstom, and entered service in 1997.
- 18 In accordance with current normal practice on the Northern line, movement of trains is controlled automatically, using the automatic train operation (ATO) system. At stations, the train operator is responsible for despatching and initiating the start of the train. Between stations, the train operator is expected to monitor the ATO system, remain vigilant and look out for any obstruction on the track ahead of the train.

¹ 1995 tube stock trains are formed of two, three-car units, which are coupled together to form six cars in normal service.

- 19 A train operator sits in the driving cab at the front of the train with a control console in front of them. This console includes the buttons normally used to operate the passenger doors, CCTV monitors (to detect potential issues at the platform-train interface) and other train controls (see paragraph 23). Trains also have a radio system for two-way communications between the train operator and the Northern line service controller. Additionally, there is an emergency 'mayday' button in the cab which the train operator can use to alert the service controller in the event of an emergency. This prioritises the call in the controller's queue.

Doors

- 20 There are two sets of sliding double doors towards the middle and a single door at each end of a 1995 tube stock car. This arrangement is the same on each side of the cars. All doors are intended for passenger use, with the exception of the single door at each end of the train which provides access to the train operator's cabs. There are also interconnecting doors between the cars of the train that allow passengers and staff to move between cars in emergency situations and when the train is stationary.
- 21 All passenger doors are normally operated pneumatically and are controlled by the train operator. An interlock system prevents the train operator from taking power unless all of the passenger doors are detected as being in the fully closed position. When the doors are fully closed, passengers have no means of opening them beyond the ability to pull them open up to around 115 mm against a spring to release trapped objects.
- 22 When the train is stationary, LUL station staff on the platform can manually open individual sets of doors by using a valve on the outside of the train called the outside door opening device (ODOD, also commonly referred to as an 'open-door valve' or 'butterfly cock').



Figure 7: Train 065 at Golders Green depot after the incident. Inset images show ODOD in normal / doors closed (top inset) and open / doors open (bottom inset) positions. Images courtesy of LUL.

Passenger emergency alarms (PEAs)

23 1995 stock trains are equipped with a PEA system (figure 8). The activation of a PEA when at least part of the train is within a platform will automatically apply the train's emergency brake. Otherwise, the train operator will be alerted that a PEA has been activated but the train will automatically continue to the next station where more assistance can be provided. The PEA system includes a talkback facility for two-way communication to take place between the train operator and passengers in the car in which the PEA has been activated. When the train operator presses the talkback button in the cab, all loudspeakers and microphones in the car concerned are switched on so the train operator can be heard throughout the car and anyone in the car can respond. Unlike some other types of LUL train stock, a train operator cannot view CCTV from inside the car after the PEA is activated. While PEA activations are recorded by on-train systems, the actual voice communications between train operators and passengers are not recorded.



Figure 8: PEA system alarm on 1995 stock. Once activated the 'Driver Aware' sign will light up (left-hand side image). When the train operator answers the PEA the 'Speak to Driver' sign illuminates (right-hand side image) allowing the passenger to communicate with the train operator. Courtesy of LUL.

24 1995 stock trains are also fitted with a public address system which allows the train operator to make announcements to the whole train. Public address announcements are not recorded. After the incident, LUL tested the PEA and public address systems on train 065 and all were found to be in correct working order.

Staff involved

- 25 The train operator of train 065 joined LUL in 2014 as a station assistant, before becoming a train operator on the Northern line in 2019. After initially working part time on the Night Tube (a service that runs on Friday and Saturday nights), they began to work full time as a train operator on the Northern line in 2020.
- 26 The customer service manager (CSM) on duty at Clapham Common station joined LUL in 1985 as a station assistant and was promoted to manage Kennington station in 1992. Since 1998, they had worked at stations across the southern end of the Northern line. At the time of the incident, they were providing meal relief for the CSM who usually manages Clapham Common station.
- 27 The customer service assistant (CSA) on duty who made their way to the platform (referred to as CSA(A)) joined LUL as a station assistant in 2005. At the time of the incident, they had been working at Clapham Common station for three and a half years.
- 28 The CSA on duty who assisted the CSM to close the station entrance gates (referred to as CSA(B)) had been working as a CSA for over 15 years.
- 29 The service manager within Highgate SCC is the senior manager on duty on the Northern line and acts as the strategic lead for any incidents that occur. This includes liaising with the network level London Underground Control Centre (LUCC) as required. The service manager also co-ordinates the activities of the following members of control room staff:
 - The service controller is responsible for managing the service on the entire Northern line. During an incident, they take the lead responsibility for managing the incident as it progresses and discharging traction current as required. They can discharge traction current from their workstation directly (known as tripping) but will then need to communicate with a power controller to confirm that the traction current remains off.
 - The signaller covering the area where the incident occurred is one of several signallers in Highgate SCC covering different service areas on the Northern line. In normal service, the signaller is responsible for monitoring the automatic signalling system and communicating with train operators as required. During incidents, the signallers will support the service controller as needed, preventing trains entering the area where the incident occurred and managing the rest of the service within their area of control. The signallers within Highgate SCC receive the same training as the service controller and are of the same grade.
 - The line information specialist (LIS) role is primarily responsible for transmitting information to other LUL staff on the Northern line and to LUCC. At the time of the incident, the LIS on duty was undergoing training under the supervision of an experienced LIS.

External circumstances

- 30 There is no evidence that external environmental conditions played a part in the incident.

The sequence of events

Events preceding the incident

- 31 The train involved in the incident (comprising units 661 and 662) entered service as train 065 at Morden station at around 07:49 hrs. The train operator booked on duty at around 13:01 hrs and took over the train shortly afterwards. There is no evidence of any issue with the train before its departed Morden station at around 17:16 hrs.
- 32 At around 17:19 hrs, the train operator of train 247, the next train to leave Morden station after train 065, reported a track fire at a set of points shortly after departing from Morden. This incident caused a series of delays across the Northern line. These affected train 065, which was held at Tooting Bec station for 10 minutes and arrived at Clapham Common station 15 minutes behind schedule.
- 33 Between around 17:25 to 17:38 hrs, staff at Highgate SCC made a series of announcements to all Northern line staff about the track fire and to expect delays. The CSM cascaded this information to passengers over the station public address system. At this time, the CSM and CSA(A) were in the Clapham Common station control room observing station CCTV and LUL's train service monitoring system. They discussed whether to put in place controls to manage passenger congestion within the station. At this time, CSA(B) was positioned towards the line of barriers in the ticket hall.
- 34 The disruption caused by the incident near Morden station resulted in larger gaps in the train service, which consequently caused an increase in the number of passengers on the platform at Clapham Common station.

Events during the incident

- 35 Around 17:42 hrs, train 065 stopped at the Clapham Common station platform. CCTV from the station platform shows smoke emanating from underneath the fourth car from the front (car 4) as it stopped. As passengers began to board and alight, some can be seen on CCTV images reacting to the smoke and looking in the direction where the smoke was emanating from.
- 36 Around 17:43 hrs, train 065 departed from the station, but was brought to a halt within seconds by a passenger pulling a PEA in car 4. The train had travelled about 35 metres before stopping, with its first two cars in the northbound running tunnel (figure 9). Around 23 seconds later, train 241 stopped on the southbound side of the platform and passengers began to board and alight from this train.

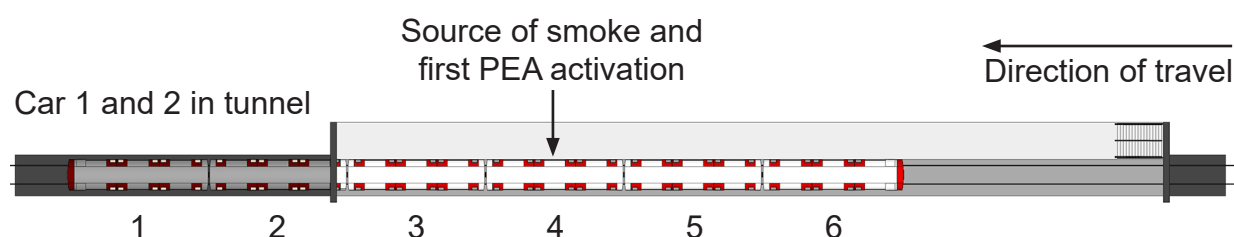


Figure 9: Detailed view of train 065 and its position on the northbound platform after coming to a halt (following a PEA activation).

- 37 Shortly after train 065 came to a stand, the train operator attempted to contact the service controller and simultaneously used the talkback facility to ask the passengers in car 4 what had happened (see paragraph 62). The train operator's call to the service controller was not answered as the controller was engaged, dealing with another incident. The train operator stated that despite attempts to communicate with the passengers on a further two or three occasions using the talkback facility, they could not clearly understand what was being said (see paragraph 69) or what was happening.
- 38 Around the same time train 065 came to a stand, a passenger, who had made their way from the platform to the ticket hall, reported smoke on the platform to the station staff. CSA(A) and CSA(B) both moved towards the platform to investigate, but the CSM called CSA(B) back to help close the station entrance gates to incoming passengers. CSA(A) continued quickly down the escalator and, while descending the stairway leading to the platform, called the CSM by radio (around 54 seconds after train 065 came to a stand) to report heavy smoke and to make a request for the station to be evacuated. CSA(A) did not receive a response from the CSM (see paragraph 97).



Figure 10: CCTV footage from the top of the stairs leading to the platform. Left-hand image shows CSA(A) moving down the stairs to access the platform during the incident with smoke visible. Right-hand image shows the platform after the incident and after smoke had cleared. Courtesy of LUL.

- 39 Around 59 seconds after train 065 came to a stand, the CSM received a call from the LIS and was instructed to call the service controller. The CSM then called the service controller and reported that station staff were evacuating the station due to reports of smoke from the platform. The service controller then discharged the electrical power supply to tracks either side of the platform and called the power controller.
- 40 At around the same time, CCTV shows that passengers on the platform began attempting to force the bodyside passenger doors of train 065 but were unable to open them more than 115 mm (paragraph 21).
- 41 At 17:44:59 hrs CSA(A), by now on the northbound platform, made a second radio call to the CSM to seek permission to open the train doors from the outside using the ODOs. Six seconds after the start of this radio call, two PHP fire alarms on the platform were activated by passengers, resulting in an automated evacuation message being played throughout the station (see paragraph 78). Eleven seconds after the second radio call from CSA(A), the CSM attempted to contact the CSA(A), but was unsuccessful (see paragraph 97).

- 42 At around 17:45:08 hrs, passengers began to leave the train through the interconnecting doors. Around 20 seconds later, CCTV shows that a passenger on the platform broke one of the train's bodyside windows with a tool. Passengers then began to leave the train from this window and then from other windows which were subsequently broken.
- 43 At around 17:45:48 hrs, CSA(A) made a third call to the CSM requesting permission to open the train doors and to report that passengers were now "panicking". Again, there was no response. At 17:46:31 and 17:46:53 hrs, CSA(A) made further radio calls to the CSM to report that passengers were now breaking the train's windows and attempting to self-evacuate. Again, no response was received to this call (see paragraph 97).
- 44 As this was taking place, the train operator attempted to contact the service controller a second time over the train radio. After a small delay the train operator was connected to the signaller. At 17:46:05 hrs, the train operator stated to the signaller that in-cab CCTV showed passengers were now climbing out of train windows.
- 45 The signaller advised the LIS of the situation and instructed them to make a radio call to all station staff at Clapham Common station which was answered by CSA(A). At 17:47:20 hrs, the LIS instructed CSA(A) to use the ODODs to open the train doors and CSA(A) immediately began to do so. The train operator, observing CSA(A) opening train doors on the in-cab CCTV monitors, made a passenger announcement to instruct all passengers to move towards the rear of the train and leave through the open doors.
- 46 At 17:58 hrs (around 15 minutes after train 065 had been brought to a stand), the last passenger is seen on CCTV to have left the platform.



Figure 11: Station CCTV footage showing the platform after the evacuation and after passengers had exited the platform. CCTV camera is pointing away from stairs (leading to the platform) with train 065 on left and train 241 on right side of the image. Courtesy of LUL.

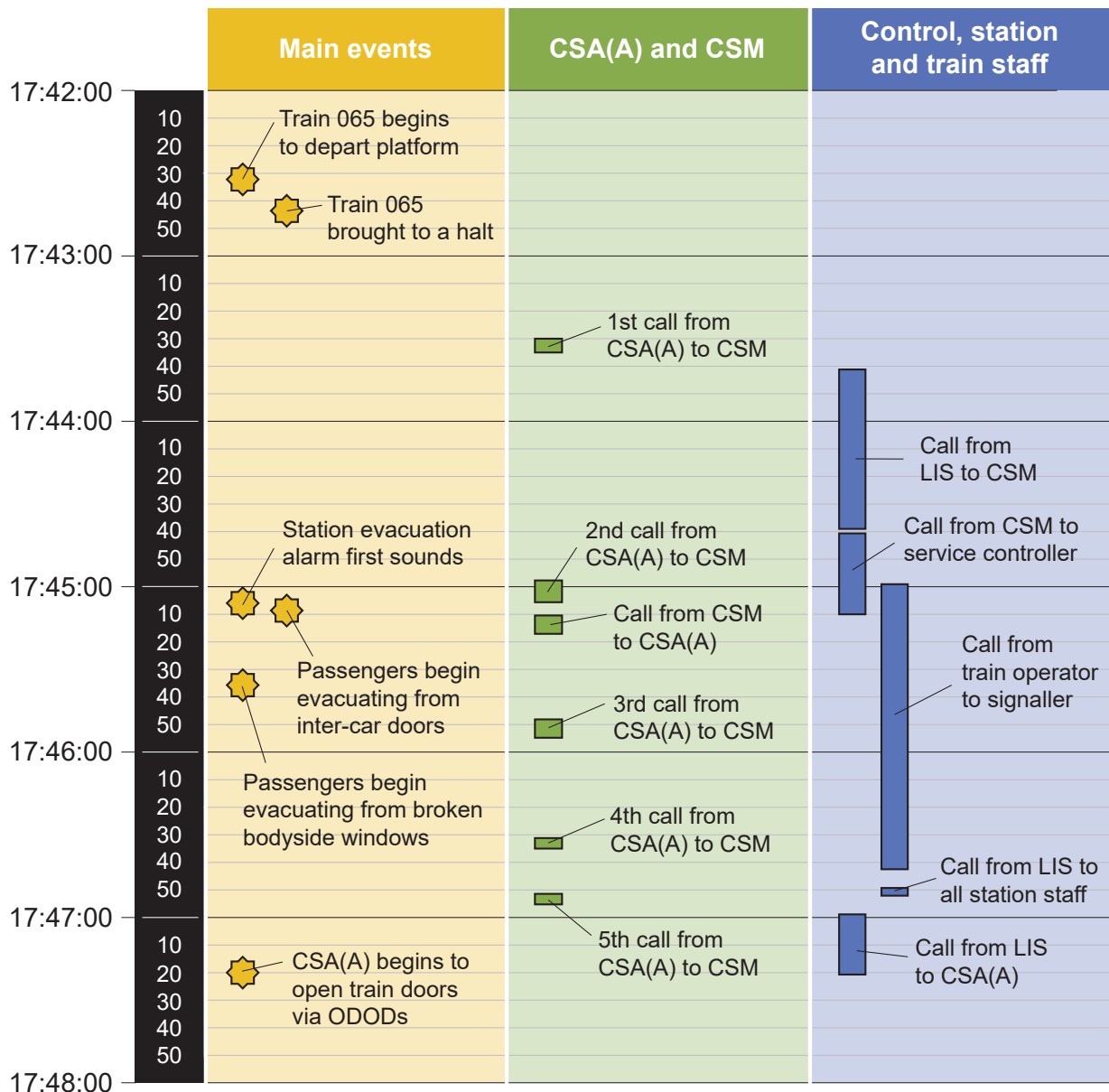


Figure 12: Timeline of communications between operational staff. The yellow section outlines some of the main events during the incident (not directly associated with communication). The green section outlines the communication between the CSM and CSA(A). The blue section outlines the communication between control staff and other operation staff (including train operator, CSM and CSA(A)).

Events following the incident

- 47 At around 17:48 hrs, LUCC contacted LFB who arrived at the station at 17:58 hrs. LFB inspected the train and the track underneath it and found no evidence of fire. The train was taken out of passenger service and travelled to Golders Green depot for further inspection by LUL and Alstom (see paragraph 63).
- 48 Passenger services on the Northern line resumed, with subsequent trains non-stopping at Clapham Common until 19:23 hrs, when the station was reopened following the removal of glass and other debris from the platform.

Background information

Brake resistors and 'brake dust' incidents

49 The build-up of dust throughout LUL's underground tunnel network occurs as a result of a number of conditions and TfL has reported that the Northern line has the highest concentrations of dust levels of any LUL line. This dust includes organic matter (such as skin and hair) and metal particles (such as iron oxide) that originate from several sources. These include the interaction between train wheels and the running rails of the track, as well as train friction braking. Friction braking results in wear occurring between a train's wheels and brake blocks, and the dust from the wear is referred to as '*brake dust*' by LUL operational staff.

50 However, during normal service, 1995 stock trains use different methods to achieve normal service braking depending on the operational circumstances:

- a. **Dynamic (electric) braking** occurs when the train's traction motors are used to generate electricity rather than to provide tractive power. This process provides retarding force to slow the train by transforming the mechanical (kinetic) energy of the rotating axles and motors into electrical energy. This energy can be either dissipated by returning it to the conductor rails to be used by other trains as tractive power (regenerative braking) or dissipated as heat in electrical resistors on the braking train (rheostatic braking). Regenerative braking is preferred as a train's braking energy can be usefully used. However, if there are no nearby accelerating trains, the traction power supply system is said to be 'unreceptive'; and rheostatic braking is used instead (see paragraph 65).

Rheostatic and regenerative braking are seen as preferable to friction braking because they avoid generating brake dust and reduce wear on components, such as brake blocks. On Northern line trains, the brake resistors used during rheostatic braking comprise a grid made up of metallic resistive elements separated by insulated ceramic dividers and are forced air cooled with a dual fan arrangement (figure 13). There are brake resistors on each car of the train fitted with traction motors (cars 1, 3, 4 and 6).

- b. **Friction braking** occurs when regenerative and rheostatic braking methods are unavailable and brake blocks are applied to the wheels of the train.

51 These braking methods are fully blended by the train's systems to achieve the desired service braking, depending on the operational circumstances. The energy to be dissipated by the resistor grid is controlled by the train's traction control system and is limited to avoid overloading the system. For example, if the amount of service braking demanded is greater than can be provided by dynamic braking, then the control system will automatically provide more friction braking to supplement the dynamic brake. Dynamic braking plays no role in emergency braking.

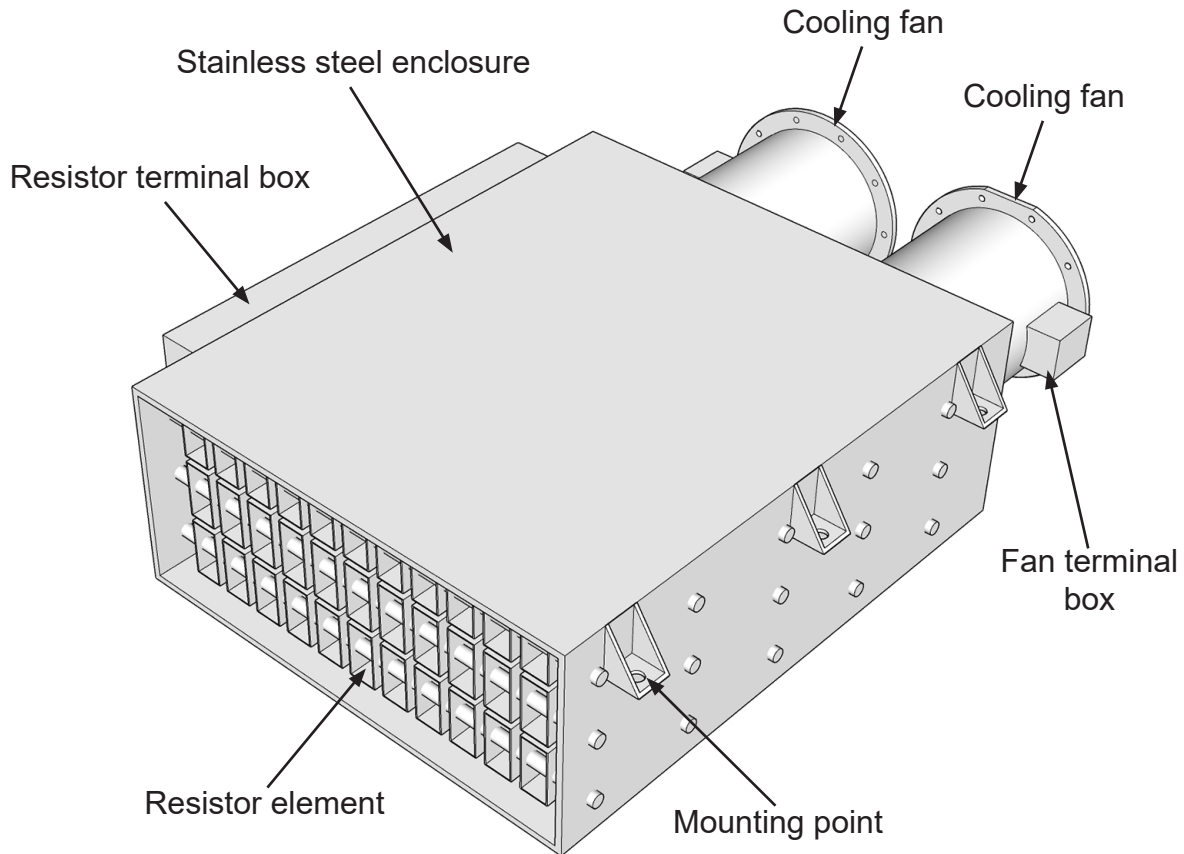


Figure 13: Diagram of a brake resistor used on 1995 stock trains.

- 52 Although the heating of clean resistor grids does not normally produce strong odours or smoke, trains operating in the tunnel environment will collect organic matter and other debris over time. If there is a sufficient build-up of this material, the heat produced on the surface of the grids can produce smoke or a burning smell. Although this is technically a different issue to the dust that is generated by friction braking, witness and documentary evidence shows that any smoke or smell from resistors heating up is also commonly referred to as 'brake dust' by LUL operational staff.
- 53 Witness evidence from station staff shows they were receiving weekly reports from passengers of smoke and a burning smell at Clapham Common station and that this also frequently occurred at other Northern line stations. These incidents were normally reported and investigated as a suspected fire but were often determined to have been due to 'brake dust' with no evidence that a fire had actually occurred (see paragraph 59).
- 54 As part of LUL's process to manage the risk of track fires, regular tunnel cleaning and train maintenance processes are employed. Cleaning activities are also undertaken following track maintenance activities (such as rail grinding²) to ensure materials used during the process are not left on or near the track. LUL's maintenance arrangements for 1995 stock trains also involve specific inspection and cleaning of the train's resistor grids to avoid excessive build-up of materials (see paragraphs 66 and 163).

² Rail grinding is a process used to reprofile and maintain rails.

Analysis

Identification of the immediate cause

- 55 The passengers, believing that they were in danger by remaining on the train, self-evacuated from the train through bodyside windows and inter-car gaps.

Identification of causal factors

- 56 The incident occurred due to a combination of the following causal factors:
- a. Once the departing train was stopped by a passenger emergency alarm, passengers perceived a significant risk from fire and became increasingly alarmed when no passenger information announcements were made, and because they could not see any effective action from LUL staff (paragraph 57).
 - b. After the train came to a stop, passengers could not evacuate via the train's doors (paragraph 83).

Each of these factors is now considered in turn.

The stopping of the departing train

57 Once the departing train was stopped by a passenger emergency alarm, passengers perceived a significant risk from fire and became increasingly alarmed when no passenger information announcements were made, and because they could not see any effective action from LUL staff.

- 58 This causal factor arose due to a combination of the following:
- a. Smoke and a burning smell associated with material on the brake resistor grid of car 4 was detected by passengers on the train (paragraph 59).
 - b. Passengers on the train did not receive suitable information from any source about the nature of the incident and actions they should take (paragraph 67).
 - c. Passengers became increasingly alarmed, and their behaviour escalated, as the train's doors remained closed and they could not see any effective action from LUL staff (paragraph 78).

Each of these factors is now considered in turn.

The presence of smoke and a burning smell

59 Smoke and a burning smell associated with material on the brake resistor grid of car 4 was detected by passengers on the train.

- 60 CCTV station footage shows that, as train 065 entered the platform and came to a stand, smoke was emanating from around the underneath of car 4 (figure 14, indicated by a red circle). As passengers began to board and alight, CCTV also shows several passengers reacting to the smoke and moving away from the immediate area. The proximity of the rising plume of smoke to the open bodyside doors makes it probable that the smoke had entered the passenger compartment of car 4 during this time. This is potentially supported by CCTV images which show that some passengers in car 4 and other cars of the train, having boarded the train, then alighted from it just before departure (see paragraph 63).

- 61 CCTV also shows the smoke had spread around the platform and was present when CSA(A) went to investigate the passenger's report of smoke (figure 10). Data from the train's on-train data recorder (OTDR) shows that seconds after the train departed the platform, a PEA was activated in car 4. This was followed by multiple PEA activations in other cars within the train.

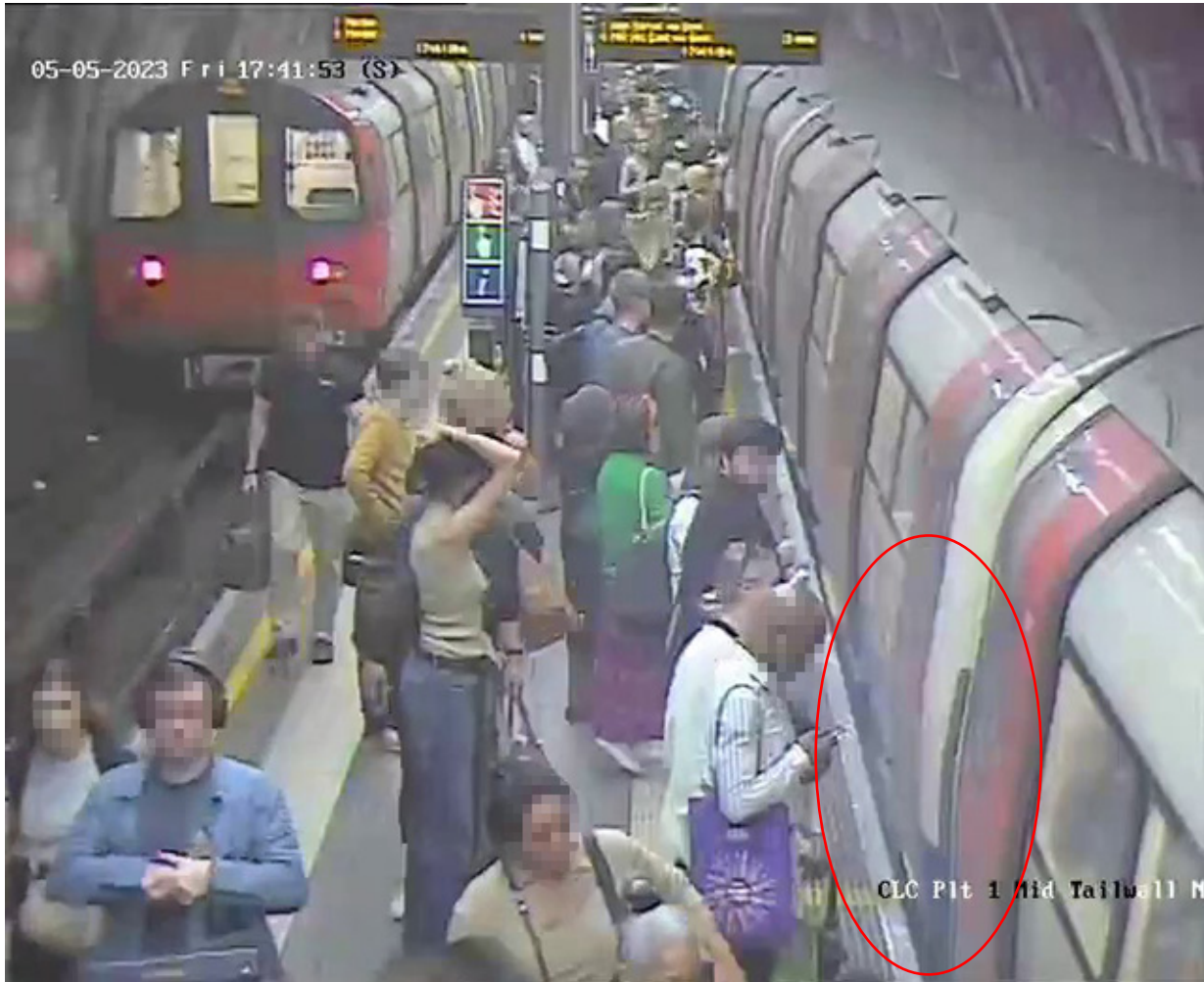


Figure 14: CCTV footage of the station platform immediately after train 065 comes to a stand initially; smoke (red circle) can be seen emanating from the underside of the leading end of car 4. A southbound train is in the process of departing the station (before train 241's arrival). The CCTV camera is facing towards the steps leading to the platform (figure 5). Courtesy of LUL.

- 62 Open source social media footage recorded by a passenger on train 065 after its departure shows passengers trying to communicate with the train operator via the PEA talkback. The recording shows passengers reporting "There's a smell of smoke burning in here and it's extreme" and "There is smoke here". RAIB has been unable to determine which car on train 065 the video was recorded within or whether this was the same car the train operator attempted to communicate with after the initial PEA activation. Other social media footage also shows the subsequent escalation of passenger behaviour in the moments before and during the self-evacuation (see paragraph 79). Following the incident, there were also a significant number of social media reports from other passengers reporting a burning smell and smoke within different parts of the train.

- 63 LUL and Alstom engineers inspected the train after the incident and confirmed that a strong burning smell was present within the passenger saloon of car 4. A subsequent inspection of the underframe of car 4 found burnt residue and a red clay-like substance on the brake resistor grid (figure 15). Independent analysis of the substances found showed that this was a mixture of organic material and a red magnetic clay substance. LUL confirmed the substance was grinding paste which is used for rail grinding activities on LUL infrastructure.



Figure 15: Remaining material found on brake resistor of car 4 of train 065 following the incident. Top left-hand image shows red magnetic clay on inlet to the resistor, bottom image shows organic material on the resistor grid and top right-hand side image shows red magnetic clay material (before material testing). Courtesy of LUL.

- 64 A review of signalling data from the time of the incident showed operational conditions where the conductor rail would not have been receptive to regenerated brake energy. This suggests that a high level of rheostatic braking would have been used by train 065 as it approached Clapham Common station.
- 65 Following the inspection of train 065, LUL engineers concluded that the likely source of the smell (and possibly the smoke) was the heating of the red clay and the organic debris on the surface of the brake resistor grid of car 4.

- 66 The inspection of car 4 found that axlebox temperatures were normal, and all brake blocks (used in friction braking) were in good order. The other cars and their underframes of train 065 were also inspected with no smell or debris on the train's resistors being found. The brake resistor on car 4 was cleaned and subsequently passed functional testing. The train was sent on a test run without any burning smell or other issues being reported. The train subsequently re-entered service, with no further similar issues reported. LUL also checked other Northern line trains and found no similar smell or debris.

Passenger information

67 Passengers on the train did not receive suitable information from any source about the nature of the incident and actions they should take.

Train operator

- 68 LUL Rule Book 7 'Train incidents and safety equipment', issue 8.1 dated November 2021, outlines the procedures a train operator should apply when a PEA is activated as a train is leaving a station platform and stops with part of the train adjacent to the platform. The steps are as follows:
- Assist train to stop;
 - Tell the controller;
 - Tell customers what has happened; and
 - Investigate the incident.
- 69 The train operator stated that following the activation of the PEA in car 4, they simultaneously began to call the service controller and used the talkback facility to ask the passengers why the PEA had been activated. Due to the noise from the passengers in the car, the train operator reported that they had difficulty in hearing what the passengers were trying to communicate. The train operator stated they attempted two or three times to clarify what had happened and reported that they believed passengers were communicating "something along the lines that there was a burning smell and some smoke". The train operator also noted that "there appeared to be a little bit of commotion".
- 70 LUL's Rule Book 1 'Communications', issue 6 dated November 2021, provides guidance to train operators about passenger announcements, including: '*The longer customers are held on a train (especially in a tunnel) the more likely they will become anxious. It is essential that regular announcements are made to make the situation less stressful*' (see paragraphs 78 and 112). The train operator reported they were aware that several other PEAs had been activated but they did not attempt to contact these passengers as they were at that time focused on contacting control (paragraph 37).
- 71 The train operator stated that shortly after they had spoken to passengers, they observed via the train's cab CCTV despatch monitors that a member of station staff (later confirmed to be CSA(A)) was on the platform.

- 72 The train operator again attempted to call the service controller. This call was diverted to the signaller. During this phone call, passengers started to self-evacuate from the interconnecting doors between the cars and later through windows. The train operator informed the signaller that they could see this occurring on the platform from the monitors within the cab. This information was shared within Highgate SCC, and it was this which led to the LIS contacting CSA(A) and instructing CSA(A) to open the train doors using the ODOD. The train operator then observed CSA(A) opening the doors and made an announcement for passengers to move towards the rear cars and exit the train (paragraph 45).
- 73 The train operator stated they had not made any passenger announcement before instructing passengers to evacuate the train. They stated this was because they had remained focused on attempting to contact the service controller (to request assistance from station staff) and to obtain directions from the controller because they were unclear as to what the situation was within the car. This delay resulted in passengers receiving no information for around four and a half minutes after the train came to a stand.
- 74 Although the train operator reported that they were unsure of the information they had received from the passengers via talkback (paragraph 69), they mistakenly concluded that the passengers were reporting a '*brake dust*' type incident. As a result of this, the train operator believed this was a relatively routine and minor operational incident, which did not require escalation or a 'mayday' emergency call to service control (paragraph 52).

Station and control staff

- 75 During the incident, the CSM and CSA(B) were engaged in closing the station's entrance gates, in accordance with LUL's evacuation procedures at Clapham Common station, and were subsequently unaware of the escalating situation that CSA(A) was attempting to manage on the platform and train. The CSM stated that had they received the radio messages from CSA(A) they would have sounded the station's automated station evacuation alarm earlier (see paragraph 78). However, it is unlikely that this action would have prevented passenger behaviour from escalating during the incident.
- 76 On receiving the report of smoke on the platform, CSA(A) immediately attended the platform to investigate. Social media videos recorded during the incident show CSA(A) attempting to instruct passengers that they should stop breaking the windows, and advising the passengers that attempts were being made to get the train's doors open. However, due to the noise from passengers on the platform and within the train, RAIB considers it is likely that the majority of passengers would not have heard the instructions given by CSA(A). CSA(A) had no means of directly making station announcements when on the platform (as these are controlled from the station control room) and therefore had little or no ability to inform passengers or to calm their escalating behaviour.
- 77 Witness and voice recording evidence shows that, until the train operator informed the signaller that a passenger self-evacuation was happening, the staff at Highgate SCC remained unaware of the escalating situation on the platform and train 065. The lack of communication and a fault with the CCTV link resulted in control room staff having reduced situational awareness and oversight of the incident (see paragraph 149).

Passenger reaction

- 78** Passengers became increasingly alarmed, and their behaviour escalated, as the train's doors remained closed and they could not see any effective action from LUL staff.
- 79 Video evidence, recorded by passengers inside train 065 and on the platform, shows passengers initially reacting to the smell of burning and the sight of smoke. The behaviour of passengers within the train appears to escalate as other passengers also became aware of the situation, with some passengers attempting to force the train's bodyside doors. Passengers on board the train can be heard expressing an immediate fear for their safety and calling to passengers on the platform to break the train's bodyside windows.



Figure 16: Still image from a video recorded by a passenger standing on the station platform. The image shows the leading double doors of car 6 during the initial stages of the incident.

- 80 Research (appendix C) into crowd behaviour during emergencies provides an insight into the passenger behaviours displayed during the incident. This research shows that decisions of individuals within crowds will depend on the information that they have available at the time, and their actions, which otherwise would be considered high-risk (such as self-evacuation from a train), may appear to be a rational choice at the time the emergency is happening. In these circumstances, an individual's choices may not be based upon a complete understanding of the risks they are being exposed to or the consequences of their actions (such as those intended to remove themselves from danger). Additionally, the perceived immediacy of the risk (such as a possible fire) and proximity of escape (for example, an adjacent platform) may also create a strong incentive for passengers to act in a certain way. Historical investigations into incidents involving the self-evacuation of trains also support this hypothesis (see paragraph 163).
- 81 The information being used by individuals to decide what actions to take can also be influenced by the reactions of other individuals in their immediate vicinity. These behaviours can create a 'feedback loop' where emotions of individuals within a crowd environment can escalate and affect other individuals who may not have otherwise perceived a risk in the same environment. Research shows that this 'emotional escalation' is more likely to occur in densely crowded environments and may continue unless and until information from a credible or authoritative source (such as an announcement from a train operator or other staff) is made to inform those affected about the nature of the situation and the actions they should take.
- 82 In this incident, a combination of events affected the passengers' perception of risk. The smell of burning and smoke coincided with the train doors remaining closed, and a lack of information and perceived action by LUL staff. During this time there were also automated announcements advising evacuation of the station heard by passengers on the platform (and possibly some within the train). The combination of events led to the behaviour of some passengers to quickly escalate, causing around 100 passengers to self-evacuate the train.

Train doors

83 After the train came to a stop, passengers could not evacuate via the train's doors.

- 84 This causal factor arose due to a combination of the following:
- a. The train operator could not open the train doors adjacent to the platform without also opening doors within the running tunnel (paragraph 85).
 - b. CSA(A) did not open the train doors because they did not apply the emergency Rule Book procedure for ODODs (paragraph 89).
 - c. Having decided authorisation was needed, there was a delay in CSA(A) gaining authorisation to use ODODs (paragraph 97).

Each of these factors is now considered in turn.

Operator door control

85 The train operator could not open the train doors adjacent to the platform without also opening doors within the running tunnel.

- 86 The 1995 stock trains have selective door operation which enables the trains to call at shorter platforms at some Northern line stations. During normal service in ATO, this is managed automatically by the train's control systems. In manual operation (or if the train does not automatically achieve an accurate stop), train operators can press buttons which prevent the first and last set of double doors opening (known as the front and end door cut outs) when the rest of the doors are opened. If a train stops at a point where any other doors are not in the platform, the train operator is instructed to call control who will call station staff to manually open the train doors.
- 87 During the incident, train 065 was brought to a stand with its first two cars beyond the platform (figure 9). In these circumstances, the train operator could not open the doors adjacent to the platform (the rear four cars) without also opening doors on the front two cars. Doing this would have resulted in doors opening into the tunnel and in a situation where passengers could potentially have attempted to exit the train directly into the tunnel.
- 88 The train operator, who was unclear as to what was happening, believed that the controller would provide guidance and instructions as to what should be done.

Emergency procedure to use ODODs

89 CSA(A) did not open the train doors because they did not apply the (emergency) Rule Book procedure for ODODs.

- 90 CSA(A), upon arrival on the platform, assessed the situation. They stated that their first consideration when they observed passengers attempting to force the train's bodyside doors, was to use the ODODs to open the train doors and allow passengers off the train but they believed they should gain authority to do so from the CSM (see paragraph 116).
- 91 The use of ODODs is covered in LUL Rule Book 8 'Managing the platform train interface', issue 6 dated November 2021, which provides instructions to station staff in managing assisted despatch when a train is positioned partially within a platform. The section states: *'You must not operate the outside door open device except in an emergency or when instructed to do so by the train operator'*.
- 92 The instructions in Rule Book 8 do not provide a definition of an *'emergency'*. Witness evidence shows LUL training material and guidance on the circumstances where this emergency procedure would apply was provided to some station staff (see paragraph 125).
- 93 In this case, CSA(A) had not received any instruction from the train operator (either directly or via the control or CSM) to operate the ODODs and defaulted to the normal station procedures to gain authority from the CSM (paragraph 91). There was no evidence that CSA(A) was aware of the emergency procedure shown within Rule Book 8.
- 94 LUL training staff reported that in non-emergency circumstances station staff will contact the train operator. However, where a train operator is not readily contactable (for example, as in this case, due to the driver's cab being outside platform limits), they would expect station staff to seek permission to use the ODODs via service control before operating them (see paragraph 122).

- 95 However, in this case, as all station duties and instructions were normally managed and directed by the station CSM, CSA(A) reverted to normal procedure and attempted to contact the CSM. CSA(A) made repeated requests and was conscious of the escalating situation. They initially believed the delay in the CSM responding was likely due to the CSM speaking to control and that the CSM would eventually return the call.
- 96 With no guidance or instruction being provided, and the behaviour of passengers escalating, CSA(A) reported they decided to use the telephone on the tunnel headwall to call service control directly. They were in the process of walking to the telephone when they received a radio message and instruction from the LIS to use the ODODs.

Delay in authorisation to use the ODODs

97 Having decided authorisation was needed, there was a delay in CSA(A) gaining authorisation to use the ODODs.

- 98 After a passenger had reported smoke on the platform to station staff, the CSM left the station control room, recalling CSA(B) to assist them in closing the station entrance gates to prevent passengers from entering the station and directing passengers to leave the station. Voice records show the CSM was at this time communicating their actions to the LIS and the service controller. The CSM's actions were in accordance with the Congestion Control and Evacuation Plan (CCEP) for Clapham Common station. However, they resulted in the CSM being unable to observe the situation on the platform (via the CCTV monitors in the control room) and therefore left them reliant on situation reports from CSA(A).
- 99 At around 17:44:59 hrs CSA(A) made a request to the CSM to evacuate the train. However, at this time the CSM was still on a radio call to the service controller (paragraphs 41 to 43). At 17:45:10 hrs, the CSM finished the call to the service controller and attempted to contact CSA(A) and stated over the radio that they were in the process of shutting the station gates. Witness evidence indicates that the CSM heard a partial response from CSA(A) which included the words "permission to open doors". However, the CSM did not hear the full content and context of the message. Witness evidence is that the CSM asked CSA(A) to restate their message, although such a message was not present in the recording of the radio call examined by RAIB. CSA(A) stated that they did not recall hearing any messages from the CSM, possibly because of the noisy environment on the station platform. The CSM did not make further attempts to contact CSA(A) to understand the context of the message.
- 100 CSA(A) made three further attempts to contact the CSM via radio before obtaining direction to use the ODODs from the LIS (paragraphs 45 to 47). Witness evidence indicates that if the CSM had successfully received the request for permission to use the ODODs from the CSA(A), they would have also defaulted to contacting service control for authorisation.
- 101 The CSM stated that there was substantial noise from the road outside the station entrance and that passengers were also shouting during the incident. The noisy environment may have prevented the CSM from hearing the radio messages from CSA(A) either in part or in whole.

- 102 The CSM stated that during the incident they had also become aware of a radio call from the LIS requesting a response from “any station staff at Clapham Common”. However, the CSM decided that this message was likely to be related to the ongoing service disruption and, rather than respond to the LIS, they decided that the task of closing the station gates was a higher priority. As a result, the CSM did not acknowledge or respond to the LIS’s message until later when they became aware of CSA(A) being directed to use the ODODs.
- 103 The CSM, having closed the station gates was in the process of walking towards the platform when they heard the communication between CSA(A) and the LIS to use the ODODs, and at this point they became fully aware of the escalating situation that had occurred on the platform.

Identification of underlying factors

LUL procedures and training

104 LUL did not provide operational staff with the procedures or training needed to effectively identify and manage incidents where passenger behaviour can rapidly escalate and cause a more serious safety incident.

105 New LUL train operators receive three weeks of classroom training on a variety of subjects, including rules and procedures. They are then required to complete a further 9 to 12 weeks of practical training, depending on the line they will be operating on, before being assessed and qualified to enter service. Train operators then enter a two-year period of enhanced competence monitoring and development, before becoming a fully qualified train operator. After this two-year period, train operators then receive a yearly one-day competency development programme (CDP) training day.

LUL Rule Book procedures and training relating to actions of the train operator

- 106 LUL’s Rule Book 7 includes procedures for a PEA activation that causes a train to stop with part of the train adjacent to the platform (paragraph 68). It directs train operators to ‘*tell the controller*’, ‘*tell customers what had happened*’ and then ‘*investigate the incident*’.
- 107 Following the PEA activation, the train operator attempted to make contact with service control in parallel to using the talkback facility to respond to the initial PEA (to determine the cause of the incident). However, the initial call to the controller was unsuccessful, and the train operator had misinterpreted the nature of the incident. As a result, they did not consider the need to make a mayday call to control or provide any announcements to passengers on the train (paragraph 74).
- 108 However, LUL’s training material for the same operational process (lesson 4-09, version 2 dated December 2013) which was current at the time of the incident and when the train operator was in initial training (in 2019) instructed new train operators to complete the following:

‘If the passenger emergency alarm is activated when the train is berthed in the platform, or whilst part of the train is in the platform, what action must the train operator take? [Answered below]:

- *Tell service controller.*

- *Sound whistle to alert station staff.*
- *Attempt to investigate incident’.*

109 LUL Rule Book 6 ‘General train operations’, issue 7 dated November 2021, states that train operators should sound one long whistle to attract the attention of station staff. However, the requirement to sound the train’s whistle in response to a PEA activation was not included in Rule Book 7.

110 This analysis shows that there was a disparity between the Rule Book instructions and the training material provided to new and existing train operators, with the training material also not including the requirement to inform the passengers on the train. LUL training staff stated that the training material did not include a requirement to make a passenger announcement because they believed the Rule Book was unclear on how the requirement to ‘*tell customers what had happened*’ should be achieved, and if this was either to be via the talkback facility to the car in question, or via the passenger announcement to the whole train. LUL training staff noted communication via talkback would be restricted and only inform the passengers in the car that the PEA was activated in and not the other cars of the train.

111 RAIB’s investigation into the Holland Park incident in 2013 ([RAIB report 16/2014](#), see paragraph 127) found that this Rule Book instruction was, at that time, generally understood to mean that the train operator should make an announcement to the whole train. The evidence from LUL training staff concerning training material suggests that the Rule Book instruction to ‘*tell customers what had happened*’ following a PEA activation may no longer be generally understood to mean that there is a need to make a passenger announcement.

112 In addition to the Rule Book procedures and training material, LUL provided train operators with a leaflet (dated 2010) referencing LUL standard 1-312 ‘Automated audio and visual information in public areas of stations and trains’, issue A2 dated 2006. This standard is not referenced in the Rule Book but is included within initial and annual refresher training. The instructions within the leaflet directed train operators to make passenger announcements regarding service disruptions to explain:

- *‘the reason for the disruption;*
- *the expected repercussions; [and]*
- *the estimated time of recovery; ...*

... Additionally, if a train is stationary between stations, customers shall be given details about the delay as soon as possible and no longer than 30 seconds from when the train has stopped; and then at intervals no longer than three minutes after that.’

113 Following the incident at Holland Park station in 2013, LUL amended its annual refresher training for train operators and introduced another leaflet to provide guidance on how to respond to multiple PEA activations causing a train to stop within station limits. This directed train operators to:

- *‘Inform controller.*
- *Request assistance [from station staff, although this is not stated].*
- *Make a general public address announcement to all customers.’*

- 114 LUL training staff stated that although making a passenger announcement was not explicitly required in the training material provided (paragraph 110), they would have expected any train operator to complete an announcement if they encountered an unscheduled stop as a result of such an activation.
- 115 Documentary evidence shows that during competency assessments train operators were only assessed and observed during scenarios involving normal service conditions and not within 'out-of-course' scenarios. However, during the January 2023 assessment of the train operator involved in this incident, it was noted that they had successfully made regular passenger announcements and informed passengers of unscheduled stops and other service disruptions.
- 116 LUL management staff stated that they believed the instructions provided to train operators prioritised informing the controller over making an initial passenger announcement because the controller will have strategic overview and can better manage the potential impact of stranded trains (including those on approach and ahead of the incident). However, if a train operator cannot contact the controller, no guidance is provided within the Rule Book or training on prioritising the passenger announcements in the interim period (see paragraph 163).
- 117 LUL initial training for train operators and the annual refresher training delivered to train operators covered LUL standard 1-312 'Automated audio and visual information in public areas of stations and trains'. This training included a leaflet outlining that passengers expect to be reassured by train operators when trains are stationary between stations or when they are held at a platform. Additionally, the leaflet states that passengers need information so they can make decisions about their journey and that they can become anxious and confused if they don't receive this.
- 118 LUL training material for train operators included some scenarios that simulated communication with passengers via talkback. However, these scenarios were primarily focused on managing challenging individual passenger behaviour (such as that due to intoxication). Following the LUL incident at Holland Park station in 2013 (see paragraph 127), a scenario where a suspected train fire led to a passenger self-evacuation was incorporated into the training. However, this was discontinued in 2016 before the train operator (of train 065) receiving initial training as a train operator (see paragraphs 127 and 135).
- 119 LUL provides train operators with wider non-technical skills training to help them understand the principles behind decision-making in an emergency situation, such as assessing the situation and understanding the problem using the available information. Although training was provided in safety-critical communications between LUL operational staff (such as train operators and control staff) there was no formal training provided to train operators to explain the importance of communication with passengers during a potential emergency, such as a suspected fire (see paragraph 163).
- 120 LUL training staff believed that some trainers may use scenarios as part of their delivery of non-technical skills training but there was no guarantee that this was consistently delivered by all training staff within the training programme.

Procedures and training relating to station staff

- 121 New CSAs at the same grade as CSA(A) receive two weeks of classroom training. They are then required to complete a further week of practical training on the line they will be operating and a final week of classroom training on customer service. CSMs need to have previously completed CSA initial training and then complete an additional three weeks of classroom training and two weeks of line training, covering the assets they will be managing at their specific location. Both CSAs and CSMs then enter a two-year period of enhanced competence monitoring and development before becoming fully qualified. Fully qualified CSAs and CSMs will receive an annual classroom reassessment (which includes rules and procedures) and a second annual reassessment on the line they are operating on.
- 122 There was no evidence that CSA(A) was aware of the emergency procedures for using the ODODs (within Rule Book 8) and instead used the normal station procedures to gain authority from the CSM (paragraph 91).
- 123 CSA(A) stated that their initial and annual refresher training included using the ODODs in non-emergency scenarios, for example, removing an unwell passenger from a train. They also reported they had practical experience of doing this in 2018 to 2020. CSA(A) stated that, in both training and in practice, they would always seek permission from the CSM to use the ODODs. The CSM would speak to control or the train operator before confirming it was safe to do so. Witness evidence from other operational staff and LUL's training team also indicates that permission was always required to use the ODODs.
- 124 CSA(A) stated they had participated in station evacuation drills conducted at Clapham Common station and other stations they had worked at. However, during these exercises the platform would either be empty or have a train fully berthed within the platform. Their training had never included an emergency evacuation of a partially platformed train and they had never received a briefing on incidents where this had previously occurred.
- 125 LUL training staff stated that during training for some CSA roles (including those relevant to CSA(A)), some trainers had reinforced the safety learning by using a video of the passenger self-evacuation incident at Holland Park station in 2013. This was used as an example of a situation where station staff did not require authorisation to operate the ODODs. However, the LUL training team stated that the use of the video was not a formal part of the course material and that its use was dependant on the trainer delivering the course. Witness evidence shows CSA(A) was not aware of the Holland Park incident.

Learning from previous incidents

126 LUL did not fully retain and apply the learning from a similar previous incident at Holland Park station. This is a possible underlying factor.

- 127 In August 2013, a Central line train departing Holland Park station was brought to a halt by a passenger activation of a PEA. A passenger reported smoke and a smell of burning within the train. RAIB investigated this incident and found a causal factor was that passengers believed their safety was at risk, that they had observed little or no response from the train operator and that they could not see any staff on the platform to deal with the situation. In the four minutes before the train doors were opened, around 13 passengers climbed out of the train via the interconnecting doors between the train cars.
- 128 RAIB made six recommendations as a result of this incident including that LUL should review its rules, procedures and training where multiple PEAs have been activated and part of a train is stopped in a station (recommendation 2). This review was to pay particular attention to helping operators to make appropriate and timely announcements. Another recommendation (recommendation 5) asked LUL to review its training for dealing with out-of-course events on trains in platforms and consider how best to prepare station, train operator and control staff to respond to such events (see paragraph 158).
- 129 In October 2015, the safety authority for railways in Great Britain, the Office of Rail and Road (ORR) reported to RAIB that it considered these recommendations to be implemented.³ In its response to recommendation 2, LUL had reported that it had updated its training material to provide train operators of all its rolling stock guidance on dealing with multiple passenger alarms. LUL also identified that its existing rules were fit for purpose and stated that:
- 'The [existing] rules require the train operator to tell the customers what has happened, before investigating the incident ... had the train operator followed these rules ... passengers would have been kept informed ... and the train detained in a controlled way.'*
- 130 In its response to recommendation 5, LUL stated to ORR that it had created a desktop scenario within its training programme where groups of operational staff could role play the events during the Holland Park incident and reflect and discuss their proposed actions and decision-making. LUL stated that it would deliver this as part of a wider suite of forty out-of-course event scenarios. It would begin to deliver CDP training to staff in September 2015 and that all affected staff would be trained by January 2017.
- 131 LUL also reported that as part of the CDP training, LUL instructed train operators to *'Use talkback where available, assess the situation, communicate with the customers and line controller'*. These instructions were unclear as to whether a whole train passenger announcement should be made, the sequence of activities that should be undertaken immediately after the PEA is activated and the importance of passenger announcements in this situation.
- 132 Witness and documentary evidence also indicates that this training was delivered as part of the annual refresher training for existing train operators but was not included in the initial training for new train operators. LUL did not formally provide the training to service control or station staff (paragraph 130).

³ <https://www.orr.gov.uk/sites/default/files/om/raib-holland-park-2015-10-13.pdf>.

- 133 In 2016, LUL reviewed its training for new and existing train operators and condensed its annual refresher training from four days to one day. This resulted in the Holland Park scenario being removed from the training programme (see paragraph 162g). Documentary evidence shows that information was still nevertheless provided to train operators during training on evacuation and the requirements of Rule Book 7. This uses a scenario for a stranded train between stations and, where the train is partially platformed, requires train operators to call service control and request station staff to open the train doors via the ODOs. However, the guidance provided within the training was not included in Rule Book 7 which covers the emergency evacuation of a train.
- 134 The operator of train 065 stated they had no knowledge of the events surrounding the Holland Park incident as it was not included within their initial training in 2019 or their subsequent annual refresher training.

LUL's identification of passenger evacuation risk

135 LUL did not identify the risk of passenger evacuation from a partially platformed train, in particular at narrow island platforms, such as at Clapham Common. This is a possible underlying factor.

Northern line risk management for stations and trains

- 136 The customer risk assessment (CRA) for Clapham Common station covered eight other stations on the Northern line (known as the 'south group' and covering stations between and including Morden to Clapham North). The risk of passenger self-evacuation from a train either positioned fully or partially in a platform was not identified on the station CRA.
- 137 The risk of a passenger falling from the platform onto the track where a train is not present was not included within the CRA. Additionally, the CRA did not consider the potential additional risk associated with the narrow island platforms at Clapham Common and Clapham North stations. These location-specific features could significantly increase the risk (including the likelihood of passengers falling from the platform onto the track without a train present) but were not considered within the CRA (see paragraph 148).
- 138 Passenger self-evacuation was considered in the CRA for Northern line trains, but no explicit consideration of passenger self-evacuation at station platforms was included.

Quantified risk assessment

- 139 LUL assessed operational risk at a high-level using the London Underground Quantified Risk Assessment (LUQRA), a mathematically based analytical model.
- 140 LUQRA considered the risk of passenger self-evacuation on the Northern line due to a fire within a tunnel and onboard a train (both originating in the passenger saloon or the train's undercarriage). The model includes the risk of passengers self-detraining to a track in both a tunnel environment or an overground section between stations and considers the likelihood of passenger fatalities during these events. The LUQRA model only considers the risks arising from a passenger self-evacuation following a confirmed train fire, the frequency of which is very low. As such, the model does not consider the risk from self-evacuation due to suspected fires (that is those which are not later confirmed). Hence the model underestimates the overall frequency (and subsequent level of risk) from self-evacuation.

- 141 Before a fatal accident at Waterloo station in 2020 ([RAIB report 05/2021](#), see paragraph 160), LUQRA expressed the severity of consequences as a number of fatalities per annum and did not consider the risk from non-fatal injuries. At the time of the incident at Clapham Common station, LUL was in the process of updating its LUQRA model to include non-fatal injuries and reported in January 2023 that it planned to fully complete this work by 2026.
- 142 Witness evidence from staff involved in the development of the LUQRA models was that, although passenger self-evacuation from trains at station platforms could foreseeably be seen to result in injuries, they did not foresee any circumstances that would result in such an event leading to a fatal accident. However, the incident at Clapham Common station suggests that the potential consequences of such an evacuation could be more serious, for example, where they occur at narrow island platforms where a second train is not occupying the other side.

Risk-based training needs analysis

- 143 In 2019, LUL reviewed its risk-based training needs analysis (RBTNA) for new and existing train operators. An RBTNA is an analysis which is intended to identify how the risks associated with work tasks can be minimised, and to inform decisions about how to manage competence.
- 144 The RBTNA included reviewing the instructions within LUL Rule Books 6, 7 and 8 to determine whether training material needed updating. It specifically included train operator actions associated with:
- a. the activation of a PEA as a train is departing a station
 - b. fire, arcing and fusing on a train
 - c. emergency detrainment between stations.
- 145 The RBTNA did not include a review of the activities associated with emergency evacuations of passengers from a train positioned partially within a platform. LUL staff involved in managing the RBTNA process believed that this activity was probably not included because this type of incident was not referenced in the Rule Book. This resulted in the review team making no amendments to the instructions within Rule Book 7 'Train incidents and safety equipment' or the training material associated with the emergency evacuation of trains.

Factors affecting the potential severity of consequence

- 146 LFB confirmed that no fire had occurred when they attended the scene.
- 147 While only relatively minor injuries were reported after the incident, passengers egressing between cars on the train were at risk of potential injury by falling into the gap between the train and the track. Additionally, because of the narrow island platform at Clapham Common station passengers self-evacuating from the train and the broken windows onto the platform may have been at risk of falling onto the southbound track without the arrival of train 241.

148 As a result of the suspension in service, a northbound train (247) with around 500 to 600 passengers onboard was stalled behind train 065 for around forty minutes without power. It arrived at Clapham North station (the next northbound stop after Clapham Common) at 18:24 hrs and passengers were disembarked. No injuries were reported from any of passengers on the stalled train.

Observations

The availability of station CCTV images to line control staff

149 The non-availability of station CCTV images in Highgate SCC meant that line control staff had no appreciation of the escalation in passenger behaviour on the platform.

150 At the time of the incident, the workstations within Highgate SCC were unable to display station CCTV from Clapham Common station because of a fault in the video link between the station and the control room. This resulted in staff within the control room being unaware of the escalating situation on the platform until they were informed by the train operator that passengers were climbing out of the train.

151 LUL managers stated that, even if the link had been operational, there are no procedures requiring line control staff to check station CCTV if there is a potential emergency (such as suspected fire) reported at that station. Furthermore, decision-making during an emergency response is primarily based on conversations being instigated by the operational staff involved. Although the provision of CCTV is intended to aid decision-making during emergency response it is not used for making safety-critical decisions.

152 While an operational CCTV link (see paragraph 162d) may have assisted the effectiveness of line control staff to manage communications with operational staff during the incident, RAIB does not consider that it would have had the potential to have prevented the uncontrolled evacuation itself.

Summary of conclusions

Immediate cause

153 The passengers, believing that they were in danger by remaining on the train, self-evacuated from the train through bodyside windows and inter-car gaps (paragraph 55).

Causal factors

154 The causal factors were:

- a. Once the departing train was stopped by a passenger emergency alarm, passengers perceived a significant risk from fire and became increasingly alarmed when no passenger information announcements were made and because they could not see any effective action from LUL staff (paragraph 57, **Recommendation 1**). This causal factor arose due to a combination of the following:
 - i. Smoke and a burning smell associated with material on the brake resistor grid of car 4 was detected by passengers on the train (paragraph 59).
 - ii. Passengers on the train did not receive suitable information from any source about the nature of the incident and actions they should take (before the automated station evacuation alarm sounded, paragraph 67).
 - iii. Passengers became increasingly alarmed, and their behaviour escalated, as the train's doors remained closed and they could not see any effective action from LUL staff (paragraph 78).
- b. After the train came to a stop, passengers could not evacuate via the train's doors (paragraph 83, **Recommendation 1**). This causal factor arose due to a combination of the following:
 - i. The train operator could not open the train doors adjacent to the platform without also opening doors within the running tunnel (paragraph 85).
 - ii. CSA(A) did not open the train doors because they did not apply the (emergency) Rule Book procedure for ODODs (paragraph 89).
 - iii. Having decided that authorisation was needed, there was a delay in CSA(A) gaining authorisation to use ODODs (paragraph 97).

Underlying factors

155 The underlying factors were:

- a. LUL did not provide operational staff with the procedures or training needed to effectively identify and manage incidents where passenger behaviour can rapidly escalate and cause a more serious safety incident (paragraph 104, **Recommendation 1**).

- b. LUL did not fully apply and retain the learning from a similar previous incident at Holland Park station. This is a possible underlying factor (paragraphs 126 and 163(g), **Recommendation 2**).
- c. LUL did not identify the risk of passenger evacuation from a partially platformed train in particular at narrow island platforms, such as at Clapham Common. This is a possible underlying factor (paragraph 135, **Recommendation 3**).

Additional observations

156 Although not linked to the incident on 5 May 2023, RAIB observes that:

- a. The non-availability of station CCTV in Highgate SCC had the potential for line control staff having reduced situational awareness and no appreciation of the escalation in passenger behaviour on the platform (paragraph 149).

Previous RAIB recommendations relevant to this investigation

157 The following recommendations, which were made by RAIB as a result of previous investigations, have relevance to this investigation.

[Uncontrolled evacuation of a London Underground train at Holland Park station, 25 August 2013, RAIB report 16/2014, Recommendations 2 and 5](#)

158 The recommendations read as follows:

Recommendation 2

The purpose of this recommendation is to improve the ability of train operators to handle multiple passenger emergency alarms and other 'out of course' events on 1992 tube stock.

London Underground Limited should review the rules, procedures and training applying to the handling of emergency situations on 1992 tube stock where multiple passenger emergency alarms have been activated and/or where only part of the train is stopped in a station. This review should include an assessment of the ways in which train operators can best manage a situation and adequacy of existing training arrangements. Particular attention should be paid to helping operators make appropriate and timely announcements and the safe management of doors in such circumstances. Any necessary changes to existing arrangements should then be implemented and staff briefed and trained as appropriate.

Relevant outcomes of this review should also be applied to other stock as appropriate.

Recommendation 5

The purpose of this recommendation is to ensure that London Underground Limited's staff are able to respond appropriately to incidents on trains in platforms.

London Underground Limited should review the required competencies and training for dealing with out-of-course events on trains in platforms. This should include consideration of how best to prepare station staff, train operators and line controllers to respond to such events in a rapid, coordinated and coherent manner, to protect the safety of passengers and station users.

159 The actions taken by LUL and ORR's response to both recommendations are discussed at paragraph 106.

[Fatal accident at Waterloo Underground station, London 26 May 2020, RAIB report 05/2021, Recommendation 2](#)

160 This recommendation reads as follows:

The intent of this recommendation is to provide those who are responsible for managing risk with reliable risk assessment data that enables them to identify those locations on its network where the risk of harm is highest and to better inform their decisions on the need for additional risk mitigation measures.

London Underground Limited should review and update its quantified system risk model (LUQRA) to ensure that it is consistent with:

- *current good practice in the rail industry;*
- *achieving a better understanding of how risk is distributed across its rail network;*
- *identifying potentially high-risk locations that warrant more detailed risk assessment;*
- *providing useful risk information to those with the responsibility for the safety of individual lines and stations;*
- *understanding the entire risk of harm, including that associated with non-fatal injuries; and*
- *the systematic evaluation of whether additional safety measures are justified.*

In conjunction with any updates to its quantified system risk model, LUL should review and update its safety decision making standard to clarify how the model and other risk assessment processes should be applied in practice.

161 LUL reported it was considering platform-train interface risk at station level rather than for an entire line and was focusing on platforms with the highest levels of passenger falls between train and platform. ORR reported to RAIB on 30 January 2023 that it was satisfied with LUL's actions in response to this recommendation and that it considered that the recommendation was closed.

Actions reported as already taken or in progress relevant to this report

162 London Underground Limited reported that the following actions were taken or are planned to be taken following this incident:

- a. Train 065 was examined. A review of the maintenance arrangements found the brake resistor had been cleaned in accordance with procedures. Examinations were completed on 12 November 2022 and 3 April 2023, with no issues being identified. However, LUL reported that they will review procedures to better understand the effectiveness of its cleaning regime by monitoring the build-up of debris on the brake resistors of five Northern line trains.
- b. LUL is to review its training for train operators and station staff considering topics around:
 - i. PEA talkback and guidance on use of the 'mayday' call function when receiving multiple PEAs
 - ii. use of ODODs and evacuation of passengers onto a platform
 - iii. Rule Book procedures around emergency detrainments (including ordering of announcements).
- c. LUL is to review its CRA and CCEPs for Clapham Common and Clapham North station (both stations with narrow island platforms).
- d. LUL is to review and improve the maintenance and availability of station CCTV at Highgate SCC (and other service control centres on other LU lines).
- e. LUL will engage a human factors specialist to review the incident and present further recommendations around driver workload (including alerts and alarm messages) and the audibility levels of announcements.
- f. LUL will also create a working group to better understand customer behaviour in real and perceived emergencies for both this type of incident and other high-potential incidents.
- g. LUL has introduced a database to record details of recommendations from internal and external investigations and to ensure that recommendations are tracked to completion. This will help ensure that learning from previous incidents is applied and retained in LUL's corporate memory.

Rail industry best-practice on managing passenger behaviour during incidents

163 In 2016, the Rail Safety and Standards Board (RSSB)⁴ published guidance T1065 'Identifying and Developing Good Practice in Making On-Train Announcements in the Event of an Incident: A Guide for Managers'. This aims to improve passenger announcements during rail incidents on the mainline railway and the understanding of factors that affect this within train operating companies. The guidance outlines how minor operational incidents can escalate into major safety risks when passengers self-evacuate. The main escalating factor seen from previous incidents is a lack of effective communication (defined as the provision of good quality, timely and consistent information) to help manage passenger behaviour.

⁴ A not-for-profit body whose members are the companies making up the mainline railway industry. LUL is an affiliate member of RSSB.

- 164 The incidents referred to within the guidance mainly relate to incidents on stranded trains on the mainline railway as a result of degraded on-board conditions (such as ambient temperatures and passenger personal needs) over a longer period of time. However, the guidance also references the LUL incident at Holland Park station in 2013 (paragraph 127). The guidance notes that passenger reassurance is especially important during incidents where passengers could perceive they are in immediate danger.
- 165 The guidance also highlights that a primary reason for not maintaining effective communication is that traincrew have previously prioritised operational communications (such as calls with signallers) over providing reassurance to passengers. This is because traincrew have traditionally considered passenger announcements to be important for customer care and not for safety. The research identified that training and guidance for traincrew had not effectively highlighted the risk that failing to communicate with passengers during a stranded train incident could result in the self-evacuation of passengers.
- 166 The guidance on training and procedures for traincrew included the content and timing of communication with passengers. Underpinning this guidance is a concept that traincrew should '*think like a passenger*' and consider how passengers may feel and react during an incident. The objective of having this perspective was to inform and provide traincrews with what passengers need to know and how often passengers need to be updated, to substantially decrease the risk of a passenger self-evacuation.
- 167 The RSSB guidance noted that LUL standards on passenger announcements prioritise early communication (to provide a holding message) with passengers before train operators speak to service control. However, LUL's procedures and associated training for actions following a PEA activation prioritise operational communication above communications with passengers (paragraphs 68 and 104).

Recommendations and learning point

Recommendations

168 The following recommendations are made:⁵

- 1 *The intent of this recommendation is for London Underground to review how it enables its staff to effectively respond to out-of-course events which may occur when a train is positioned partially in a platform.*

London Underground should undertake a risk-based review of its current Rule Book, operating procedures and associated training material considering the findings from this incident. This review should seek to ensure that staff have clear guidance and instructions regarding the actions to be taken when dealing with out-of-course events, such as emergency evacuations, on trains that are partially positioned in a platform. The review should particularly examine how staff communicate with passengers during such events and if existing guidance and instructions enable staff to make effective decisions in the timeframes typically available during such events.

London Underground should make any changes to rules, procedures and training material identified as appropriate following this review. London Underground should also ensure that any changes are appropriately briefed and trained to relevant train operations, station and control staff. This training should, where appropriate, include practical elements such as simulation exercises (paragraphs 154a, 154b and 155a).

- 2 *The intent of this recommendation is for London Underground to ensure that learning from previous incidents is not lost and that safety recommendations are captured and tracked through to implementation.*

London Underground should continue its review of its processes for learning lessons from operational experience. This review should ensure that it is robustly applying and retaining the safety learning identified from accidents and incidents and using this information to enhance its understanding and control of risk (paragraph 155b).

⁵ Those identified in the recommendations have a general and ongoing obligation to comply with health and safety legislation, and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail and Road to enable it to carry out its duties under regulation 12(2) to:

- (a) ensure that recommendations are duly considered and where appropriate acted upon; and
- (b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on RAIB's website www.gov.uk/raib.

- 3 *The intent of this recommendation is for London Underground to review its risk assessment processes to ensure that the risks associated with out-of-course incidents involving trains and stations are effectively identified and assessed.*

London Underground should review its risk management processes to ensure it is able to identify and effectively assess the risks associated with low frequency and potentially high-impact incidents involving trains and stations, such as passenger self-evacuation from partially platformed trains. As part of this review, London Underground should consider if the effect of factors associated with specific locations which could pose an increased risk to passengers, such as stations with narrow island platforms, is being appropriately considered within risk assessment processes (paragraph 155c).

Learning point

169 RAIB has identified the following important learning point:⁶

- 1 Train operators are reminded of the importance of providing good quality, timely and consistent information to passengers during operational incidents. This is particularly important during incidents where passenger behaviour could escalate, such as where they believe they are in immediate danger, and which could result in passengers self-evacuating from the train (paragraph 163).

⁶ Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Appendices

Appendix A - Glossary of abbreviations and acronyms

ATO	Automatic train operation
CCTV	Closed-circuit television
CCEP	Congestion Control and Evacuation Plan
CDP	Competency development programme
CRA	Customer risk assessment
CSA	Customer service assistant
CSM	Customer service manager
LFB	London Fire Brigade
LIS	Line information specialist
LUCC	London Underground Control Centre
LUL	London Underground Limited
LUQRA	London Underground Quantified Risk Assessment
ODOD	Outside door opening device, also known as ‘butterfly cock’ and open door valve (ODV).
ORR	Office of Rail and Road
OTDR	On-train data recorder
PEA	Passenger emergency alarm
PHP	Passenger help point
RAIB	Rail Accident Investigation Branch
RBTNA	Risk-based training needs analysis
RSSB	Rail Safety and Standards Board
SCC	Service Control Centre
TfL	Transport for London

Appendix B - Investigation details

RAIB used the following sources of evidence in this investigation:

- information provided by witnesses
- information taken from the train's OTDR
- CCTV recordings taken from Clapham Common station and train 065
- videos and photos recorded by passengers during the incident
- passenger statements on social media and to news organisations following the incident
- site photographs and measurements
- LUL procedures, training and guidance provided to operational staff
- meetings with LUL management and training staff
- weather reports and observations at the site
- train maintenance and technical records
- LUL investigation report (including resistor material testing)
- LUL risk assessments
- a review of previous RAIB investigations that had relevance to this incident.

Appendix C – Research on crowd behaviours during an emergency

The following research was used to better understand the behaviours of passengers during the incident at Clapham Common station (see paragraphs 80 and 81):

- ‘The decision to evacuate: a study of the motivations which contribute to evacuation in the event of fire’ published in the fire safety journal dated October 1984.
- ‘Communication of emergency public warnings: a social science perspective and state-of-the-art assessment’ prepared for the US Federal Emergency Management Agency dated August 1990.
- ‘Crowd control: how we avoid mass panic’ article published in Scientific American dated November 2010.
- ‘Experimental study on panic during simulated fire evacuation’ article published in the International Journal of Environmental Research and Public Health dated June 2022.
- ‘Public behaviour in response to perceived hostile threats: An evidence base and guide for practitioners and policymakers’ briefing document created as part of a UK Economic and Social Research Council project dated February 2023.
- ‘Simulating panic amplification in crowds via density-emotion interactions’ article published in the 2023 International Conference on Autonomous Agents and Multiagent System (AAMAS 2023) dated May 2023.

This report is published by the Rail Accident Investigation Branch,
Department for Transport.

© Crown copyright 2024

Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Email: enquiries@raib.gov.uk
Telephone: 01332 253 300
Website: www.raib.gov.uk